Staff Summary Report

Tempe

To: Mayor & City Council
Through: City Manager

Agenda Item Number 23
Meeting Date June 20, 2002

SUBJECT: Award of Request for Proposal # 02-085 – Powdered Activated Carbon

PREPARED BY: Ted Stallings, CPPB, Procurement Officer, 480-350-8617

REVIEWED BY: Ron Gauthier, CPPO, Central Services Administrator, 480-350-8405

BRIEF: Request to award a contract for Powdered Activated Carbon

COMMENTS: **Purchases (1004-01) Bid #02-085** Request to award a contract for Powdered Activated Carbon to MeadWestvaco Corporation for an estimated annual expenditure of $275,000.

Document Name: (20020620fsts03) Supporting Documents: Yes

SUMMARY: **Historical background**

For the past 19 years, the City of Tempe has successfully bid and administered supply contracts for water treatment chemicals, which have included powdered activated carbon. This new contract will allow for powdered activated carbon to be ordered and delivered on an as needed basis according to water production and seasonal needs. Powdered activated carbon is used to remove objectionable taste and odors that are caused by organic and inorganic producing bodies that occur in either raw or treated water supplies.

Evaluation Process

The Water Utilities Department and the City Procurement staff developed the specifications. Once Proposal responses were received, they were reviewed by an evaluation team for conformance to the terms, conditions and specifications of the City's Request for Proposal, as well as costs. Other evaluation factors included: powdered activated carbon performance and characteristics.

The City Procurement Office received eight- (8) proposals. All eight- (8) proposals were considered responsive.

Each proposer was required to submit a one- (1) pound sample of proposed product. Samples were submitted to ASU's National Center for Sustainable Water Supply Department of Civil and Environmental Engineering for a series of blind tests to determine each proposed product's ability to remove specific organic taste and odor causing compounds.

MeadWestvaco Corporation scored the highest on the ASU blind sample test for product quality and offered the lowest price per pound of powdered activated carbon. Products from Acticarb, Inc., Calgon Carbon Corporation, CarbonUSA LLC, Pacific Carbon LLC, Norit Americas, Inc. and Thatcher Company of Arizona scored lower on the ASU blind sample test for quality and had higher per pound prices.

Based on the proposal's evaluation criteria the following scores were received.

PROPSAL OFFERER	CUMULATIVE SCORE
Acticarb, Inc.	20
Calgon Carbon Corporation	24
Cal-Pacific Carbon LLC	34
CarbonUSA LLC	24
CarbonUSA LLC – Alternate bid	24
MeadWestvaco Corporation	44
Norit Americas, Inc.	36
Thatcher Company of Arizona	32

FISCAL NOTE: Funds have been appropriated in 3013, 3014, 3022, 3033, 3034, 3122, 3123, 3133 and 3144-6310.

RECOMMENDATION: It is recommended that the City Council award a two- (2) year contract for Powdered Activated Carbon to MeadWestvaco Corporation for an estimated expenditure of $275,000.

Approved by:

Ted Stallings, CPPB
Procurement Officer

Tom Gallier
Water Utilities Mgr.

Tom Hartman
Control Center Operations

Proposal Number # 02-085

Bid Tabulation

Vendor	Cost per pound
Acticarb, Inc.	$.385
Calgon Carbon Corporation	$.50
Cal-Pacific Carbon LLC	$.30
CarbonUSA LLC	$.418
CarbonUSA LLC – Alternate bid	$.478
MeadWestvaco Corporation	$.275
Norit Americas, Inc.	$.311
Thatcher Company of Arizona	$.289

ARIZONA STATE UNIVERSITY
National Center for Sustainable Water Supply
Department of Civil and Environmental Engineering
Tempe, AZ 85287-5306
480/965-2885 Fax 480/965-0557
email: p.westerhoff@asu.edu

May 23, 2002

TO: Tom Hartman / City of Tempe

FROM: Paul Westerhoff

SUBJECT: Screening PAC Suppliers Bid Submissions

ASU screened eight (8) powder activated carbon (PAC) samples for their ability to remove MIB and Geosmin, with the intent of the City of Tempe partially basing the selection of a PAC supplier upon this data. This was a blind testing study; codes (A through H) were used to designate each PAC brand. ASU takes no legal responsibility for the City of Tempe decisions for a PAC supplier. Below is the testing and evaluation protocol, test findings, and results. The recommendation from this study is that the City of Tempe contract with the supplier of PAC brand "B".

TESTING PROTOCOL

Water Source. Water was collected from the Salt River (the dominant water supply for SRP during peak taste and odor (T&O) episodes). The water will be filtered (Whatman GF/F), and DOC measured. MIB will be spiked into the water for final concentrations of approximately 81 ng/L; Geosmin spiked to 58 ng/L.

PAC Batch Experiments. Activated carbon adsorption studies with MIB and Geosmin will be conducted in the laboratory with commercially available brands of PAC. PAC samples were obtained from a single batch from manufacturers in amounts sufficient to run all experiments. A total of eight (8) different PAC types will be tested. PAC doses will be set at two PAC doses (15 and 25 ppm). This was a blind testing study; codes (A through H) were used to designate each PAC brand. A PAC slurry of each PAC sample was prepared at a concentration of 2500 mg PAC/L ultra-pure water; the slurry was mixed and allowed to hydrate for 24 hours at room temperature. Amber glass bottles (250ml) were used for treatments and were shaken on a wrist shaker (Multi-wrist® shaker, Lab-Line, Melrose Park, IL). The duration of shaking was based upon the average hydraulic residence time of PAC in the pre-sedimentation basins plus flocculation basins (conservative HRTs provided by the City of Tempe – 5 hours). Activated carbon was removed from the samples by syringe

filtering with a 0.2 um nylon filter (Acrodisc® 32 Supor® 0.2 um syringe filters, Pall Corporation, Ann Arbor, MI). Control treatments containing MIB and Geosmin, but no PAC, were shaken and filtered in a similar manner as the samples containing PAC. Experiments were conducted at room temperature. All experiments were conducted in duplicate.

Measurement of MIB and Geosmin. MIB and Geosmin were measured using Solid-Phase Microextraction/Gas Chromatography Mass Spectroscopy (SPME-GC/MS) (Watson et al., 2000; Lloyd et al., 1998). Twenty-five ml of sample is added to a 40 ml septum capped vial that contains 8 gm desiccated sodium chloride and a magnetic stir bar. An internal standard (10 ng/L IPMP, Aldrich Chemical Co., Milwaukee, WI) is added through the septum and the vial is placed in a water bath on a magnetic stir plate heated to 50 ± 1.5 °C. A SPME fiber (Supelco # 57348 U) is introduced into the head space gas through the septum and the sample is stirred for 30 minutes. The fiber is removed from the vial and inserted into the gas chromatograph injector at 250 °C for 5 minutes. The fiber was then retracted into the holder, removed from the GC inlet and reused for the next sample. Compounds are eluted from the column gas chromatograph to a mass spectrometer set for selective ion storage (selective *m/z* values: MIB = 95, Geosmin = 112 and IPMP = 124, 136). Calibration curves are generated using MIB and Geosmin standards (mixture standard: Supelco # 47525 U). Method detection limit for SPME is 2 ng/L. An MIB internal standard was run in triplicate, and had excellent reproducibility: 27.5±0.8 ng/L.

RESULTS

The fraction remaining of MIB and Geosmin was calculated from experimental results. The fraction remaining is defined as C/Co, where C is the MIB or Geosmin concentration (ng/L) after contact with the PAC and Co is the initial MIB or Geosmin concentration (ng/L). The PAC brands (A through H) were ranked from best performing (lowest C/Co) to worst performing (highest C/Co) for MIB or Geosmin removal (Figure 1). The values indicated in the bar charts are the average of two separate PAC tests, and the error bar represents the difference between the average and one of the samples. At a PAC dose of 15 ppm the fraction of MIB remaining ranged from 0.59 to 0.88, with the top three performing PAC brands being: B>H>E.

At a PAC dose of 25ppm more MIB was removed than at 15 ppm, and lower fraction remaining values were observed (Figure 1). At a PAC dose of 25 ppm the fraction of MIB remaining ranged from 0.33 to 0.66, with the top three performing PAC brands having essentially equivalent MIB removal capability (brands H, E, and B).

Geosmin was removed more effectively than MIB (Figure 1). Geosmin removal at 25 ppm of PAC was greater than 65% (data not shown). Geosmin removal at a PAC dose of 15 ppm is shown in Figure 1. The fraction of Geosmin remaining ranged from 0.31 to 0.86, with the top three performing (lowest C/Co) PAC brands being: B>H>E.

INTERPRETATION OF RESULTS

After completion of the blind laboratory PAC performance testing, the City of Tempe provided unit cost data on each PAC (A through H). The unit costs provided are presented in Table 1. The three least expensive PAC brands were: B<F<D. Based upon the PAC experimental performance for removing MIB or Geosmin and the provided PAC unit costs, an Index Value was calculated. The Index Value was computed as follows:

$$\text{Index Value} = [\%\ \text{MIB Remaining}] \times [\text{Price per pound}] \qquad \text{Equation 1}$$

In principle, the PAC brand with the lowest Index Value represents the most cost effective brand of PAC. For example, a lower PAC dose could offset a higher PAC price.

Table 1 – PAC Unit Costs

PAC Brand	PAC Unit Cost ($/lb)
A	$0.311
B	$0.275
C	$0.385
D	$0.300
E	$0.500
F	$0.289
G	$0.418
H	$0.478

Index values for each PAC brand at two PAC doses (15 and 25 ppm) for MIB and 15 ppm PAC dose for Geosmin are shown in Figure 2. The Index values for the 25 ppm PAC dose and Geosmin were all quite low, given the high removal efficiency. Based the ranking of Index Values for MIB removal with 15 or 25 ppm of PAC, the same trend is observed: B < A < D. Therefore, PAC brand "B" would be the most cost effective. A summary of the Index Values and removal efficiencies are provided in Appendix A.

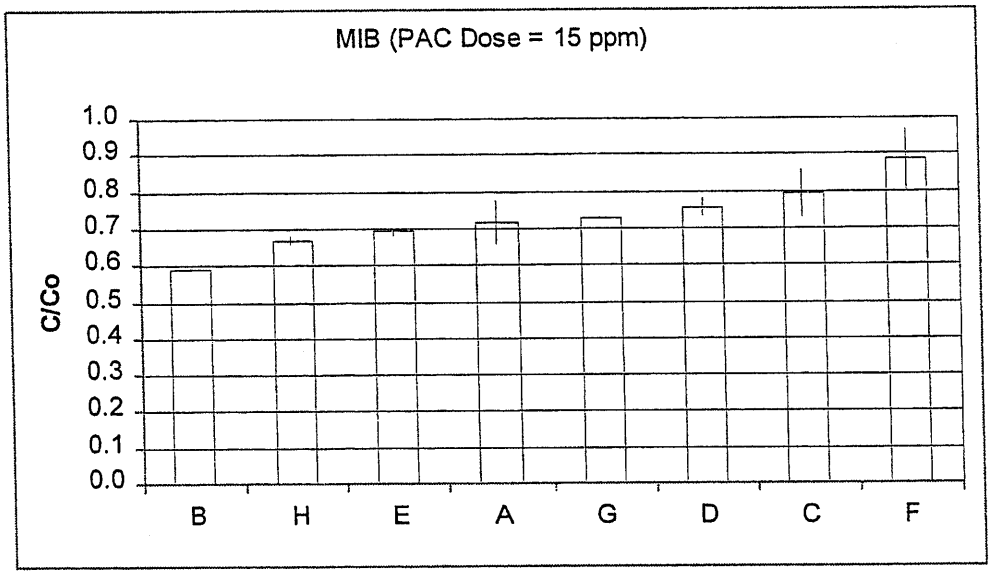
Recommendation

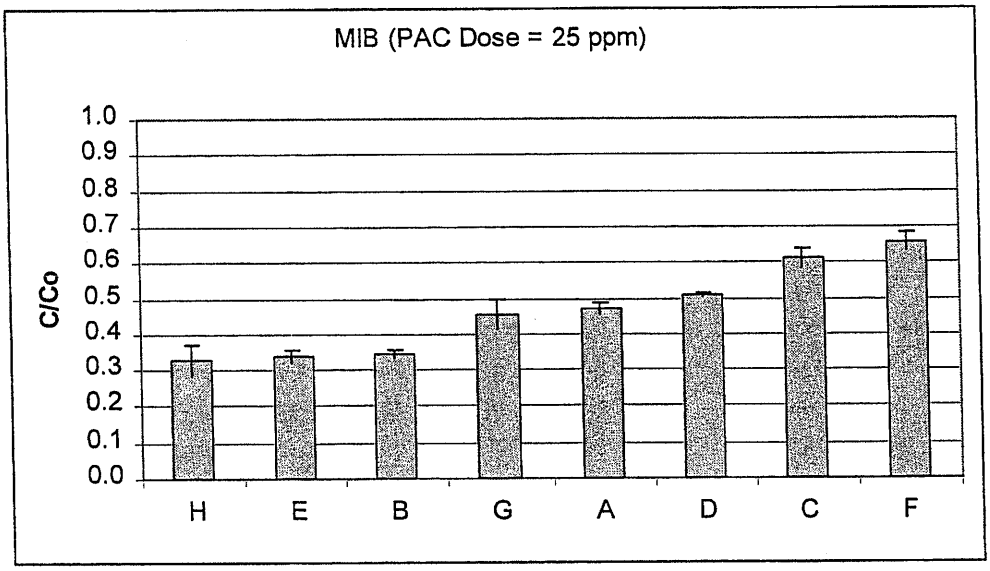
Based upon the batch PAC tests, PAC brand "B" had the among the highest MIB removal efficiency (lowest C/Co) and had the lowest unit cost. Correspondingly, brand "B" also had the lowest Index Value. Therefore, we would recommend brand "B" for the City of Tempe PAC supplier.

However, other PAC brands are capable of performing equally well in removing MIB and Geosmin. Other high performing PAC brands would include: H and E, followed by A and G. The combination of MIB removal efficiency and bid price just does not make them as good a choice as brand "B". The City may also want to consider the following issues in final selection of a PAC supplier:

- Availability of product
- Product handling issues
- Size and settling characteristics of the PAC

Figure 1 – Summary of Fraction MIB or Geosmin Remaining





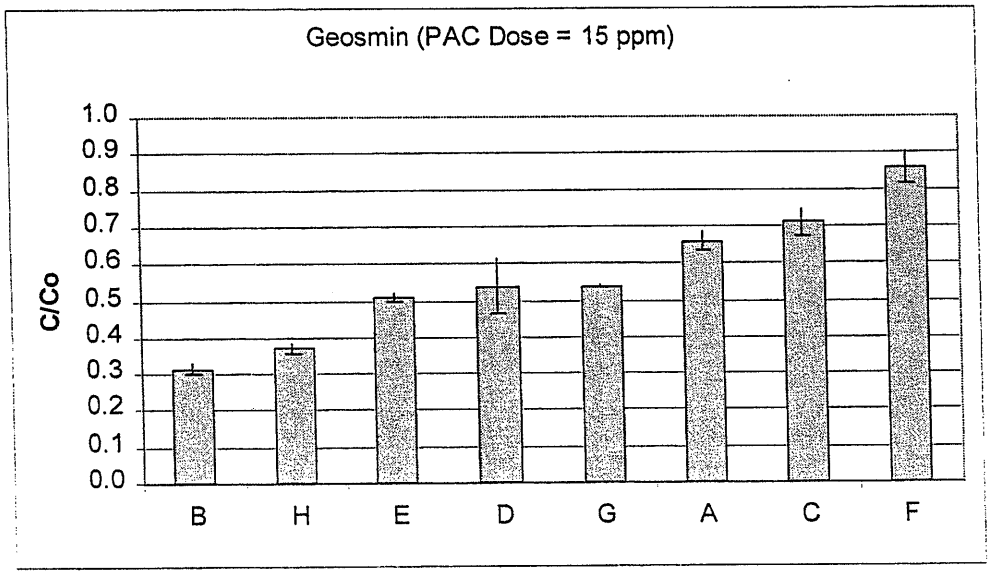
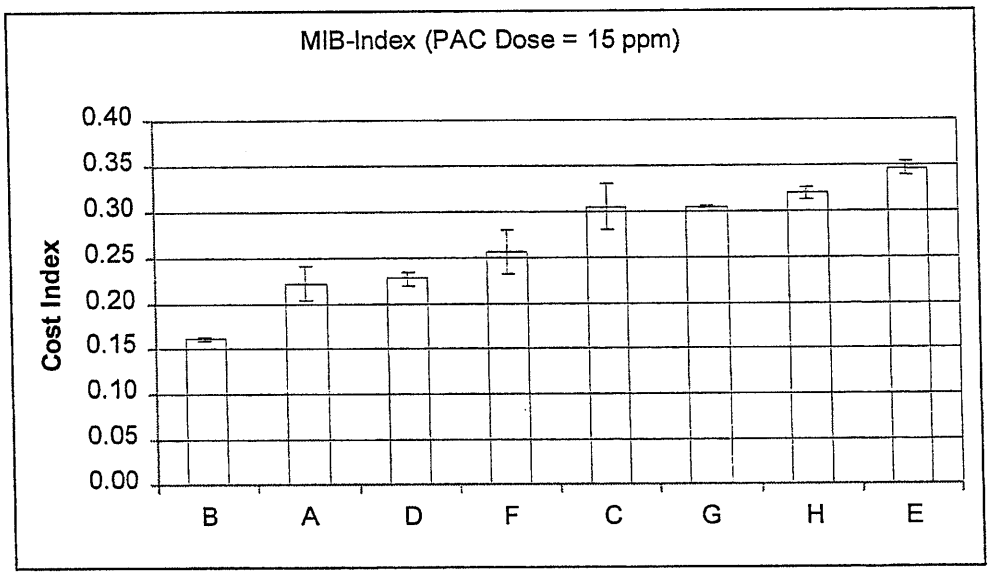
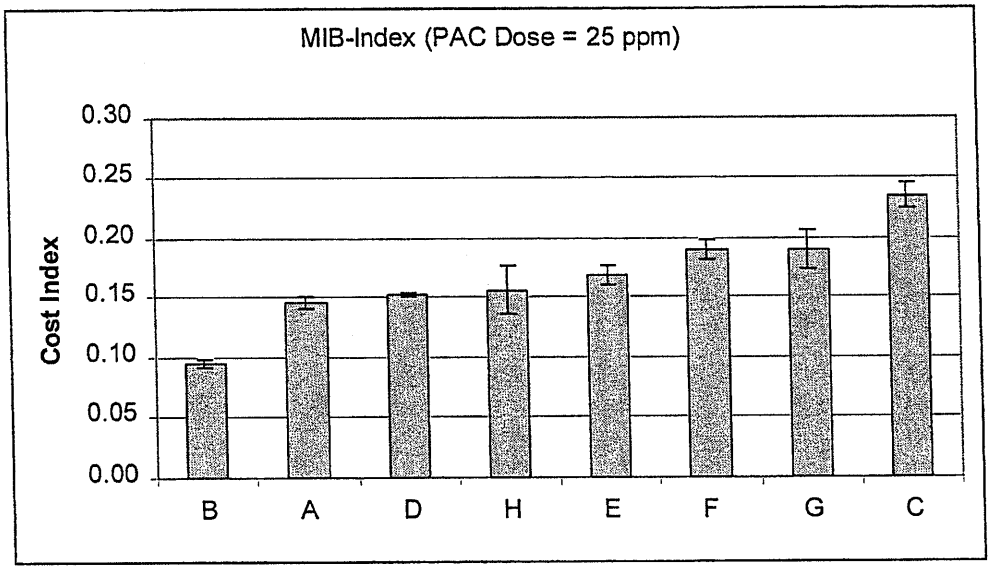
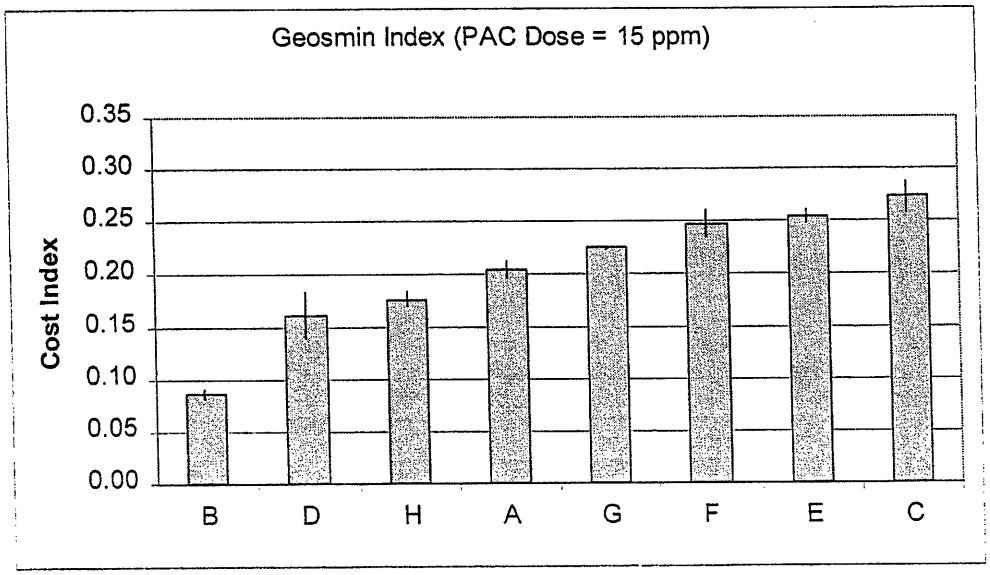


Figure 2 – Summary of PAC Index Values







Appendix A

Experimental Results and Computations

Experimental Results and Computations for 15 ppm PAC Doses

PAC Type	Cost $/lb	PAC=15ppm MIB C/Co	MIB-Index	PAC = 15ppm GEOSMIN C/Co	Geosmin Index
A	$ 0.311	77%	0.240	68%	0.213
A	$ 0.311	65%	0.203	63%	0.197
B	$ 0.275	60%	0.164	30%	0.082
B	$ 0.275	58%	0.160	33%	0.090
C	$ 0.385	86%	0.330	74%	0.286
C	$ 0.385	73%	0.279	67%	0.259
D	$ 0.300	78%	0.234	61%	0.183
D	$ 0.300	73%	0.219	46%	0.139
E	$ 0.500	71%	0.354	50%	0.249
E	$ 0.500	68%	0.338	52%	0.259
F	$ 0.289	97%	0.280	90%	0.260
F	$ 0.289	80%	0.231	81%	0.235
G	$ 0.418	73%	0.304	53%	0.223
G	$ 0.418	73%	0.305	54%	0.226
H	$ 0.478	68%	0.326	38%	0.183
H	$ 0.478	66%	0.313	36%	0.170

PAC=15ppm PAC Type	MIB-Index	Variability
A	0.222	8%
B	0.162	1%
C	0.305	8%
D	0.227	3%
E	0.346	2%
F	0.256	10%
G	0.305	0%
H	0.320	2%

PAC=15ppm PAC Type	Geosmin Index	Variability
A	0.205	4%
B	0.086	5%
C	0.273	5%
D	0.161	14%
E	0.254	2%
F	0.247	5%
G	0.225	1%
H	0.177	4%

Experimental Results and Computations for 25 ppm PAC Doses

PAC Type	Cost $/lb	PAC=25 PPM MIB C/Co	MIB-Index	PAC = 25 ppm GEOSMIN C/Co	Geosmin Index
A	$ 0.311	49%	0.151	7%	0.0218
A	$ 0.311	45%	0.141	7%	0.0224
B	$ 0.275	36%	0.098	6%	0.0170
B	$ 0.275	33%	0.092	6%	0.0160
C	$ 0.385	64%	0.245	28%	0.1081
C	$ 0.385	58%	0.225	29%	0.1101
D	$ 0.300	52%	0.155	13%	0.0385
D	$ 0.300	50%	0.151	13%	0.0390
E	$ 0.500	35%	0.176	6%	0.0283
E	$ 0.500	32%	0.161	7%	0.0325
F	$ 0.289	68%	0.198	36%	0.1039
F	$ 0.289	63%	0.183	34%	0.0990
G	$ 0.418	50%	0.207	10%	0.0415
G	$ 0.418	42%	0.174	10%	0.0429
H	$ 0.478	37%	0.177	5%	0.0262
H	$ 0.478	28%	0.135	4%	0.0196

PAC=25 PPM PAC Type	MIB-Index	Variability
A	0.146	3%
B	0.095	3%
C	0.235	4%
D	0.153	1%
E	0.169	5%
F	0.190	4%
G	0.190	9%
H	0.156	13%

PAC=25 PPM PAC Type	Geosmin Index	Variability
A	0.022	1%
B	0.016	3%
C	0.109	1%
D	0.039	1%
E	0.030	7%
F	0.101	2%
G	0.042	2%
H	0.023	14%